

LMSC NSSC-1 Target Acquisition Tests; February, 1985

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For the NSSC-1 binary search target acquisition tests of February, 1985, a star field was simulated by using a platinum lamp, the double 0"1 aperture, and the G190H grating. By processing diodes 270 through 286, this configuration resulted in a pseudo-star field containing six point sources. These sources are made up of the lines at 1907.493, 1911.702, and 1916.083 Å which are imaged once in each aperture. Using the NSSC-1 the test then attempted to find one of these sources and put it on the edge of the diode array.

For the binary search test, three of the parameters varied; YNBRT, NMAX, and NMIN. Each setting of parameters was tested with three different starting values of YBASE. Of the 16 cases run, five failed due to incorrect YBASES and an additional four failed because there were not enough y steps to put the target on the edge. These problems have been corrected; YBASE apparently needed a longer wait time when initially set in a binary search sequence, and the maximum number of y steps has been increased from five to eight. One additional case was run with NMAX and NMIN set to exclude all sources in the field. This case failed in the correct way, that is, the correct value of YGIVUP = 10 was returned.

The binary search centering accuracy in the y direction is a function of the maximum count rate and the response of the diode edge to a point source. We do a linear fit to the data to show that the slope at half of the peak signal is 3% of the response (see Figure 7). Using this value, achieving y centering to 1 micron accuracy with $\pm 3\sigma$ certainty requires that the sum of the counts per y step exceed 5000.

The target acquisition test showed that in general the software logic was correct and working. To rectify the problem with YBASEs, changes have been made in the target acquisition procedure (proc) and to rectify the problem with y steps changes have been made in the flight software. The proposed target acquisition test of August 1985 will check that these changes have been correctly implemented.

Table 1 summarizes the target acquisition test.

Table 1

Target Acquisition Test: February, 1985

Case	YNBRT	NMAX	NMIN	YBASE	Result
1	1	2000	200	36	successful
2	1	2000	200	?	wrong YBASE
3	1	2000	200	10	needed more y steps
4	2	2000	200	36	needed more y steps
5	2	2000	200	62	successful
6	2	2000	200	?	wrong YBASE
7	3	2000	45	36	needed more y steps
8	3	2000	45	62	successful
9	3	2000	45	62	successful
10	4	2000	45	?	wrong YBASE
11	4	2000	45	62	successful
12	4	2000	45	10	successful
13	3	50	10	?	wrong YBASE
14	3	50	10	?	wrong YBASE
15	3	50	10	10	successful
16	1	40,000	30,000	44	successful

CASE 1

YNBRT = 1
 NMIN = 200
 NMAX = 2000

	YBASE	YNTARG	STAR ON ARRAY	
Aperture Map	36 -220 292			Stars found = 1,4 Star selected = 1 YNMAX = 2800
Binary Search	-92 -156 -124 -108 -116	412 2657 1746 898 1370	No Yes Yes No On Edge	

Comments:

Correctly found 2 stars and selected correct star.

Converged to correct YBASE = -116.

CASE 2

YNBRT = 1
 NMIN = 200
 NMAX = 2000

	YBASE	YNTARG	STAR ON ARRAY	
Aperture Map	? -374 _140			Stars found = 1,4 Star selected = 1 YNMAX = 986
Binary Search	-244 -180 -148 -132 -124	2712 2670 2529 2104 1703	Yes Yes Yes Yes Yes	New YNMAX = 2712

Comments:

Incorrect starting Y-Base causing the first slice of the aperture map to be incorrect.

YNMAX was correctly updated in first slice of the binary search.

CASE 3

YNBRT = 1
NMIN = 200
NMAX = 2000

	YBASE	YNTARG	STAR ON ARRAY	
Aperture Map	10			Stars found = 1,4
	-246			Star selected = 1
	266			YNMAX = 2795
Binary Search	-118	1500	Yes	
	-54	46	No	
	-86	280	No	
	-102	826	No	
	-110	1118	No	

Comments:

Insufficient number of steps. Correct Y-Base = -116.

6 DAC units error causes YNTARG to be $6 \times 1.5\% \times \text{YNMAX} = 252$ counts to low. If you add 252 to YNTARG of 1118 to give 1370 counts at YBASES = -116, success would have been reached in two more steps.

CASE 4

YNBRT = 2
 NMIN = 200
 NMAX = 2000

	YBASE	YNTARG	STAR ON ARRAY	
Aperture Map	36			Stars found = 1,4
	-220			Star selected = 4
	292			YNMAX = 1207
Binary Search	164	549	No	New YNMAX = 1244
	228	1244	Yes	
	196	1054	Yes	
	180	922	Yes	
	172	741	Yes	

Comments:

Selected correct star (2nd brightest)

Did not have enough steps to converge on YBASE = 166. Would have required three more steps.

Projected counts at YBASE, $166 = 741 - (6 * 1.5\% * 1244) = 629$ which would have passed.

CASE 5

YNBRT = 2
 NMIN = 200
 NMAX = 2000

	YBASE	YNTARG	STAR ON ARRAY	
Aperture Map	-62			Stars found = 1,4
	-194			Star selected = 4
	318			YNMAX = 1197
Binary Search	190	1046	Yes	
	126	64	No	
	158	406	No	
	174	765	Yes	
	166	583	On Edge	

Comments:

Worked perfectly (lucky hit).

CASE 6

YNBRT = 2
 NMIN = 200
 NMAX = 2000

	YBASE	YNTARG	STAR ON ARRAY
Aperture Map	?		
	-90		
	422		

Stars found = None
 Star selected =
 YNMAX =

Comments:

Incorrect starting Ybase.

Software correctly recognized that no valid stars were in the field.

CASE 7

YNBRT = 3
 NMIN = 45
 NMAX = 2000

	YBASE	YNTARG	STAR ON ARRAY
Aperture Map	36		
	-220		
	292		
Binary Search			
	-92	46	No
	-156	338	Yes
	-124	249	Yes
	-108	117	No
	-116	207	Yes

Stars found = 1-6
 Star selected = 3
 YNMAX = 340

Comments:

Correctly found 3rd brightest star. Failed to converge in 5 steps.

CASE 8

YNBRT = 3
 NMIN = 45
 NMAX = 2000

	YBASE	YNTARG	STAR ON ARRAY	
Aperture Map	62			Stars found = 1-4,6
	-194			Star Selected = 3
	318			YNMAX = 320
Binary Search	-66	8	No	
	-130	250	Yes	
	-98	88	No	
	-114	185	On Edge	

Comments:

Correctly found 3rd brightest star. Converged after 4 steps.

CASE 9

YNBRT = 3
 NMIN = 45
 NMAX = 2000

	YBASE	YNTARG	STAR ON ARRAY	
Aperture Map	62			Stars found = 1-4,6
	-194			Star selected = 3
	318			YNMAX = 334
Binary Search	-66	20	No	
	-130	254	Yes	
	-98	96	No	
	-114	157	On Edge	

Comments:

Exact same case as case 8 with the exact same results.

CASE 10

YNBRT = 4
 NMIN = 45
 NMAX = 2000

	YBASE	YNTARG	STAR ON ARRAY	
Aperture Map	?			Stars found = 1,3
	-370			Star selected = 3
	142			YNMAX = 148
Binary Search				
	-242	398	Yes	New YNMAX = 398
	-178	337	Yes	
	-146	340	Yes	
	-130	265	Yes	
	-122	229	Yes	

Comments:

Started with wrong Y-Base and therefore only found 2 valid stars in the aperture map. The 4th brightest was to be selected. It therefore (correctly?) searched for the 2nd brightest.

CASE 11

YNBRT = 4
 NMIN = 45
 NMAX = 2000

	YBASE	YNTARG	STAR ON ARRAY	
Aperture Map	62			Stars found = 1-4,6
	-194			Star selected = 2
	318			YNMAX = 273
Binary Search	-			
	-66	7	No	
	-130	194	Yes	
	-98	69	No	
	-114	135	On Edge	

Comments:

Found correct peak and converged.

CASE 12

YNBRT = 4
 NMIN = 45
 NMAX = 2000

	YBASE	YNTARG	STAR ON ARRAY	
Aperture Map	10 -246 266			Stars found = 1-4,6 Star selected = 2 YNMAX = 256
Binary Search	-118	136	On Edge	

Comments:

Worked correctly and converged to YBase = -118 in one step. It converged to 114 in the previous case showing variations of 4 DAC units can result if counting statistics are poor.

CASE 13

YNBRT = 3
 NMIN = 10
 NMAX = 50

	YBASE	YNTARG	STAR ON ARRAY	
Aperture Map	? -374 138			Stars found = A,B,2-4 Star selected = 2 YNMAX = 86
Binary Search	-246 -182 -150 -134 -126	225 198 178 233 131	Yes Yes Yes Yes On Edge	New YNMAX = 225

Comments:

Wrong Y-Base, peaks A & B are very weak and do not appear in the countour plot. Selected correct peak in Aperture Map. In the first step of the binary search, the selected star had a peak count of 95 counts and was no longer valid.

CASE 14

YNBRT = 3
 NMIN = 10
 NMAX = 50

	YBASE	YNTARG	STAR ON ARRAY	
Aperture Map	?			Stars found = 2-4
	-382			Star selected = 2
	130			YNMAX = 54
Binary Search				
	-254	304	Yes	New YNMAX = 304
	-190	240	Yes	
	-158	294	Yes	
	-142	184	Yes	
	-134	203	Yes	

Comments:

Same thing happened as with Case 13.

CASE 15

YNBRT = 3
 NMIN = 10
 NMAX = 50

	YBASE	YNTARG	STAR ON ARRAY	
Aperture Map	10			Stars found = 5
	-246			Star selected = 5
	266			YNMAX = 100
Binary Search				
	138	4	No	
	202	126	Yes	New YNMAX = 126
	170	44	No	
	186	92	Yes	
	178	89	Yes	

Comments:

Only one valid star found. It performed the binary search on that star.

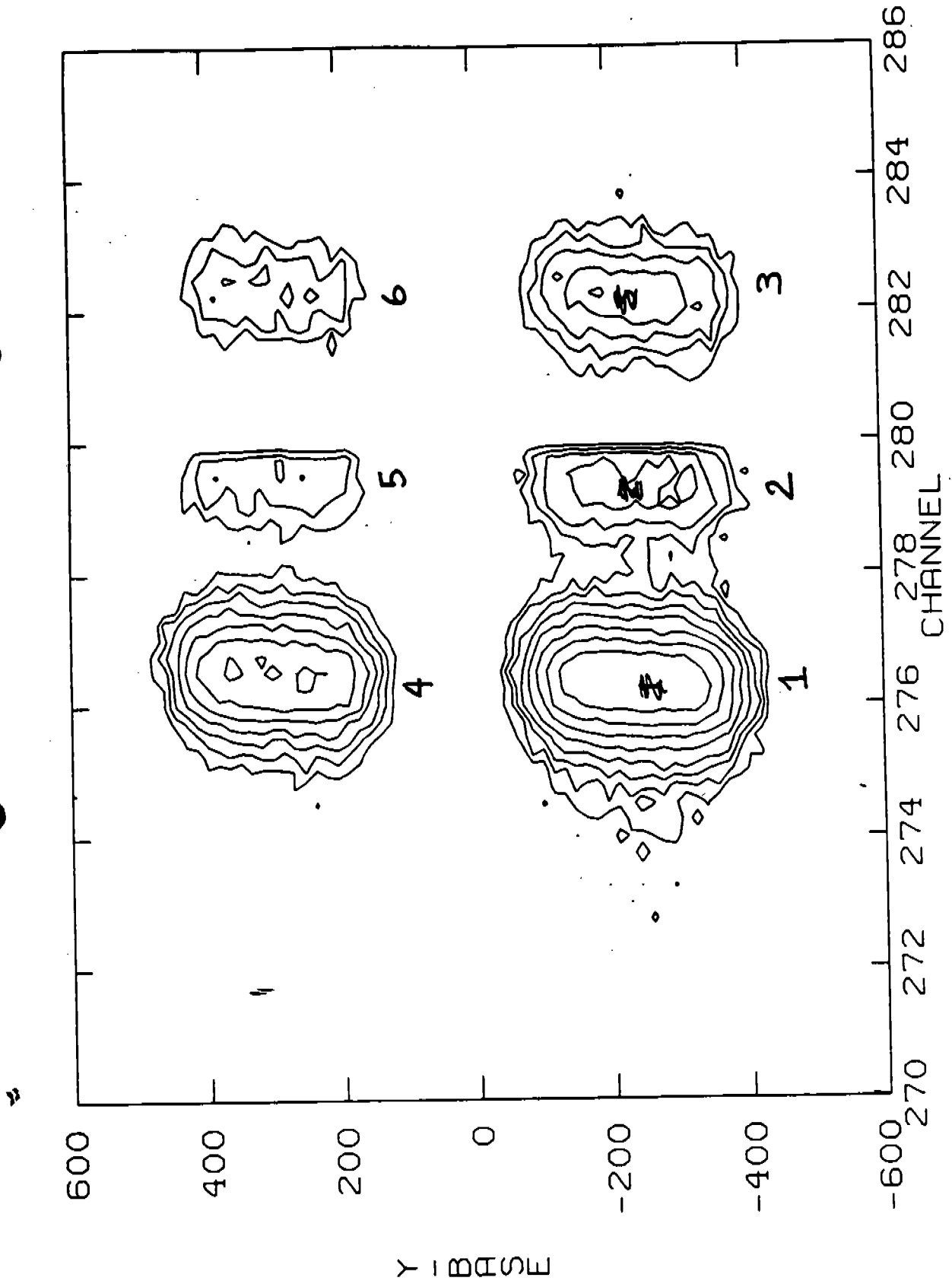


Figure 1: Simulated 4"3 star field using platinum lamp through 0"1 paired aperture.

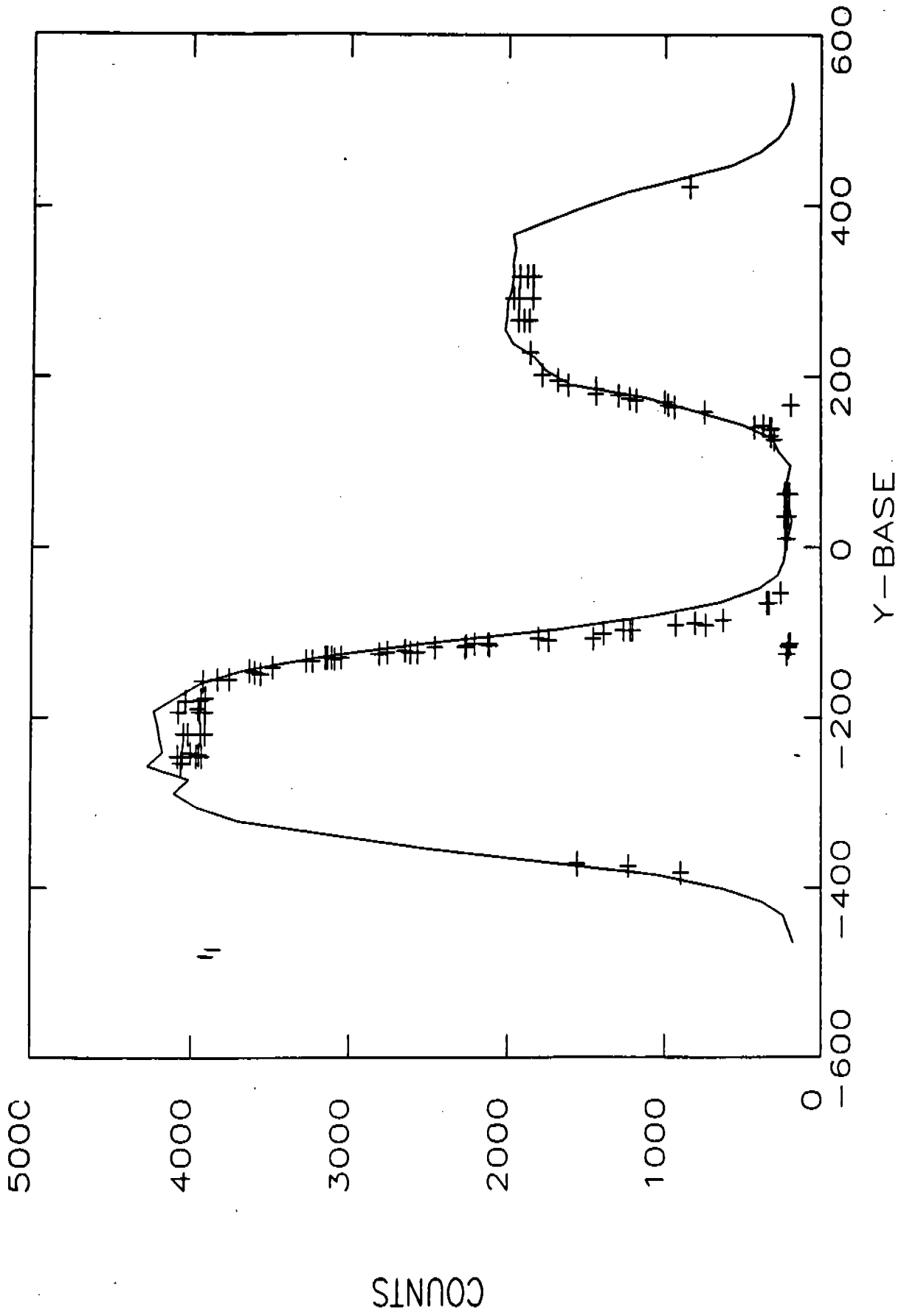


Figure 2: Profile of Y scan (solid line) and total counts from all target acquisition frames (+'s).

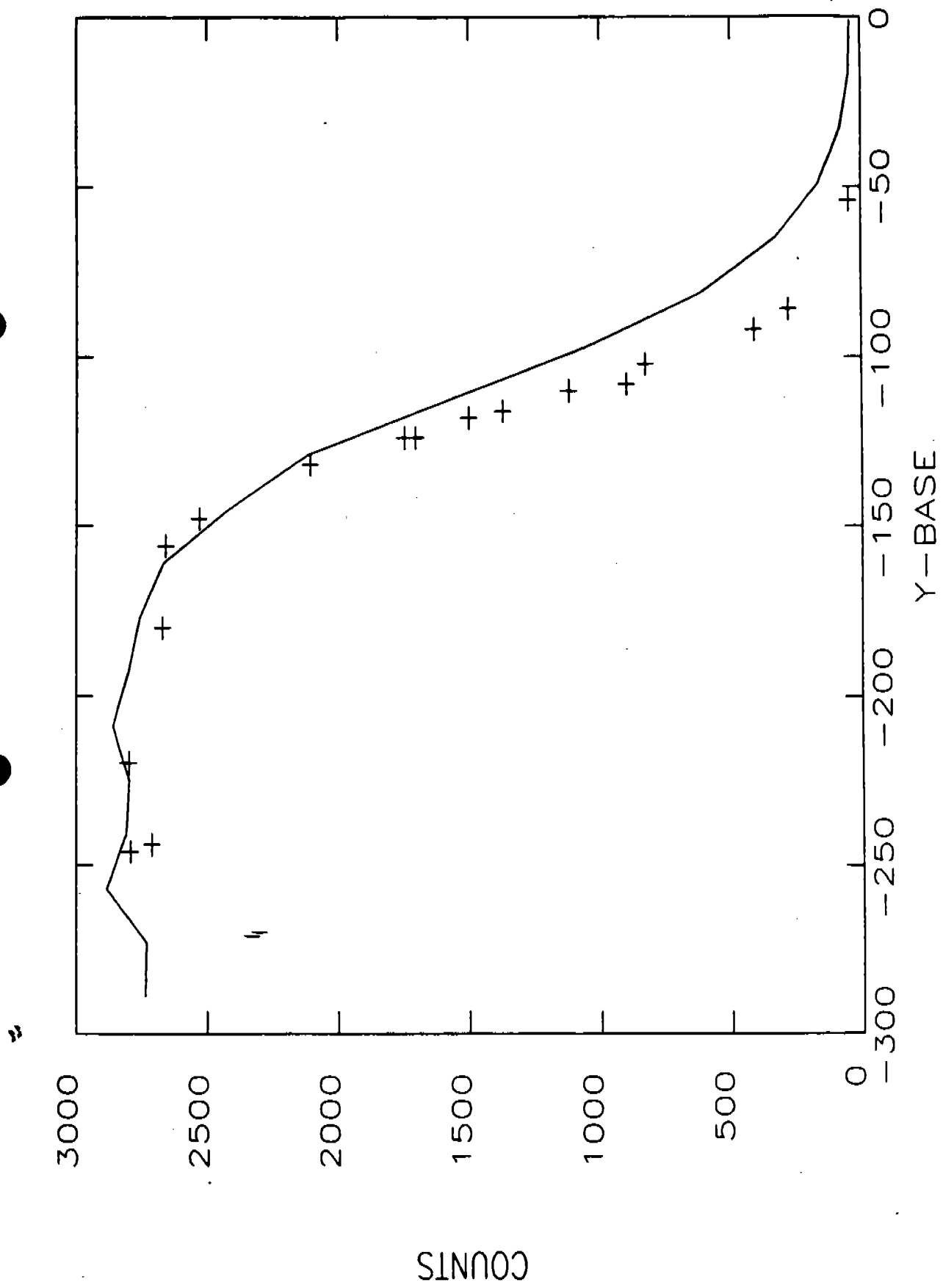


Figure 3: Blow up of Figure 2 between Y-BASE -300 and 0.

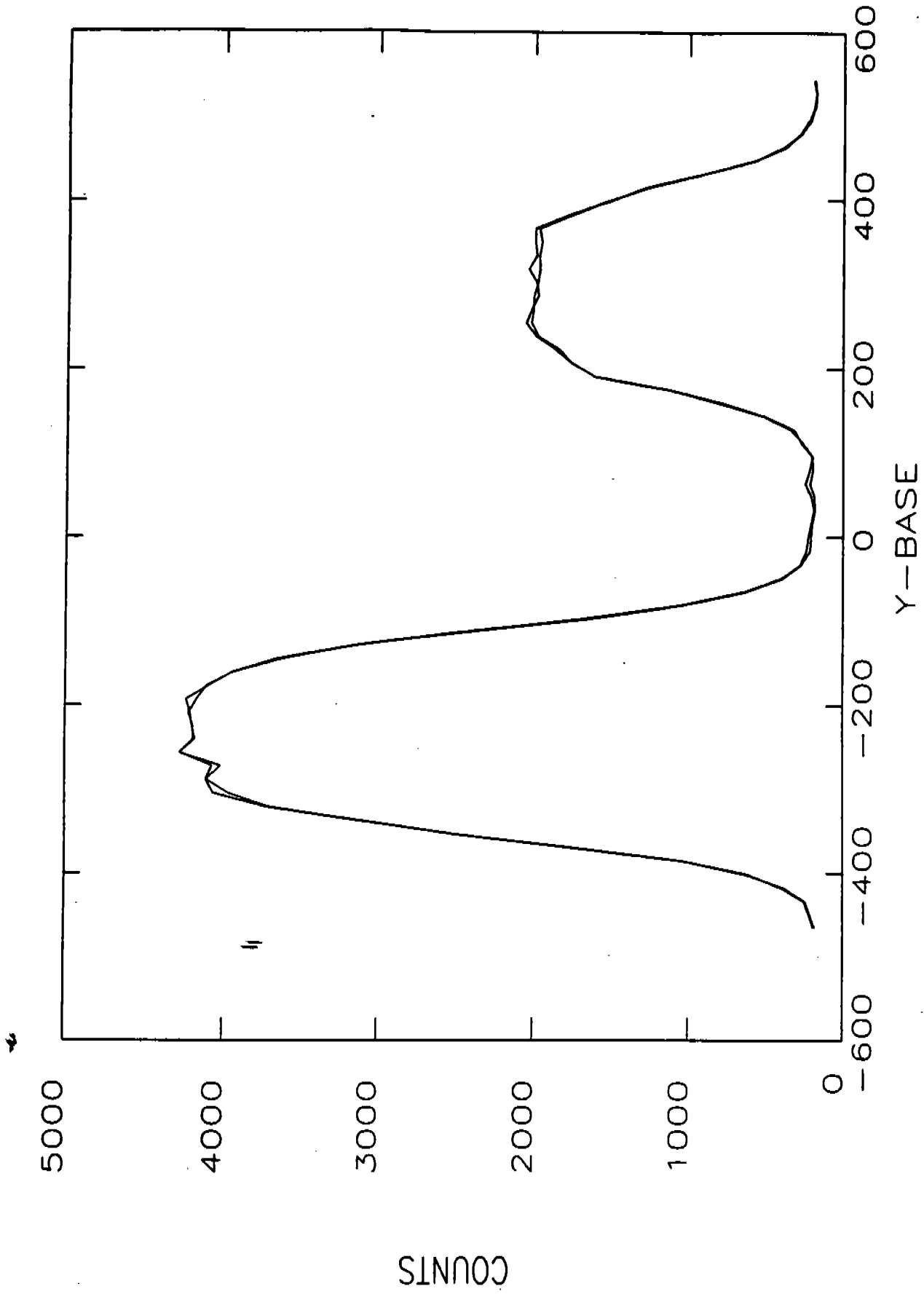


Figure 5: Comparison of total counts versus Y-BASE and normalized counts in channels 274 to 277.

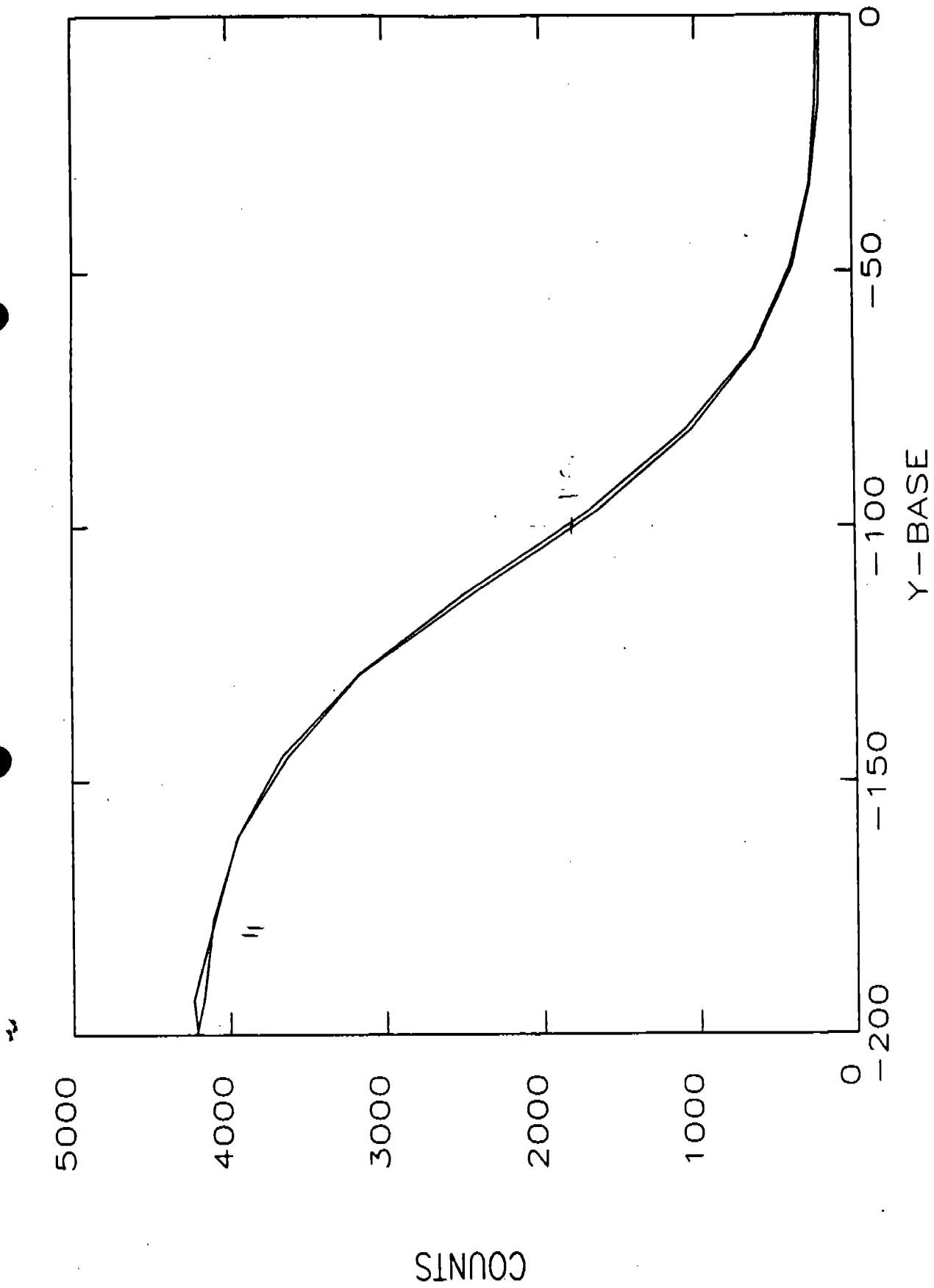


Figure 6: Blow up of Figure 5 between Y-BASE -200 and 0.

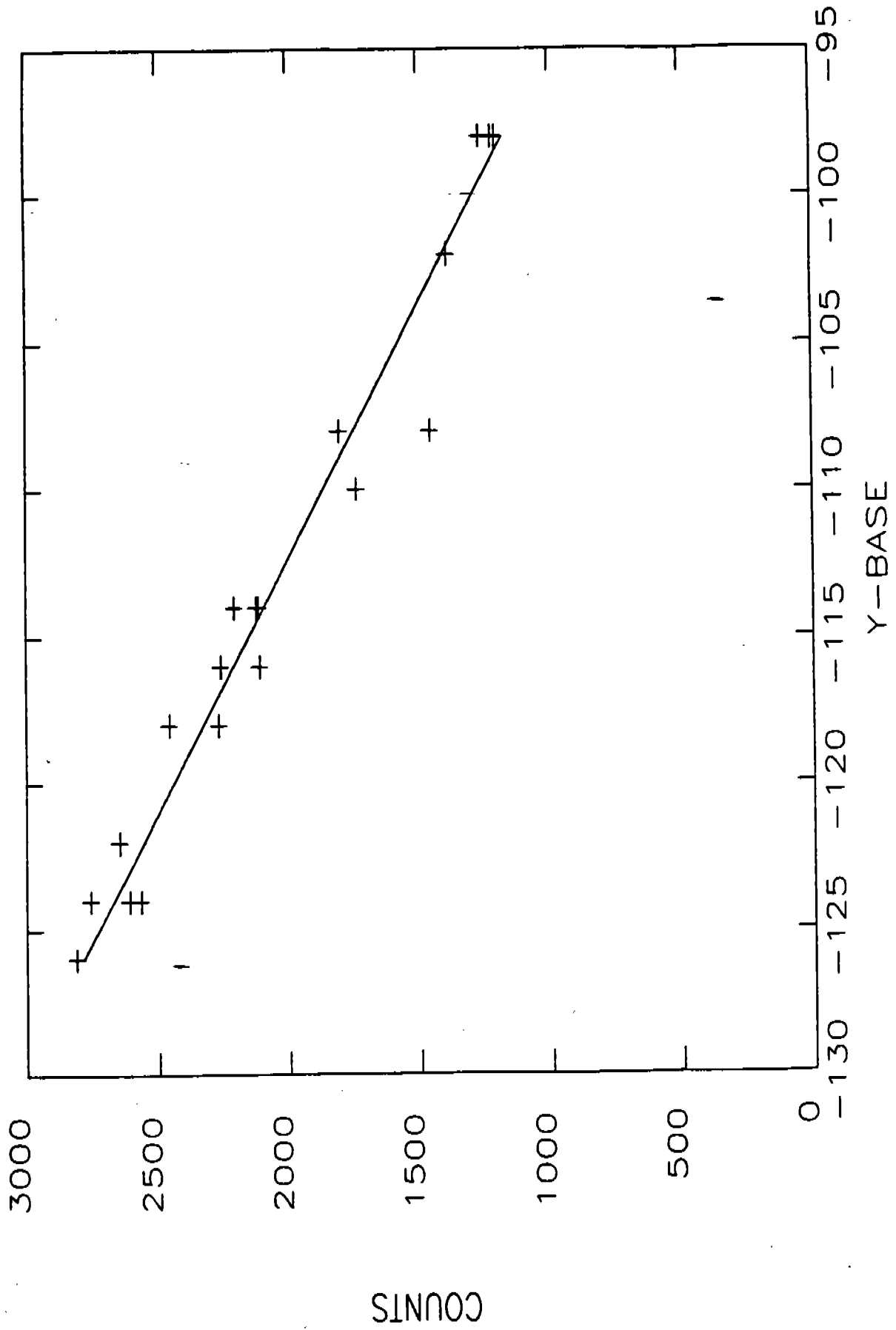


Figure 7: Linear fit to edge response.